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Vol. 27, No. 8

PSYCHOLOGICAL REVIEW PUBLICATIONS

October, 1930

Psychological Bulletin

EDITED BY

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PUBLISHED MONTHLY (EXCEPT AUGUST AND SEPTEMBER)

FOR THE AMERICAN PSYCHOLOGICAL ASSOCIATION
BY THE PSYCHOLOGICAL REVIEW COMPANY
PRINCETON, N. J.

Entered as second-class matter at the post-office at Princeton, N. J., with an additional entry at
Albany, N. Y.

PUBLICATIONS of the American Psychological Association

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Review, Bulletin, J. Exp., and Index: \$18.00 (Foreign, \$18.75).

Subscriptions, orders, and business communications should be sent to the

PSYCHOLOGICAL REVIEW COMPANY

PRINCETON, N. J.

Vol. 27, No. 8

October, 1930

THE
PSYCHOLOGICAL BULLETIN

NINTH INTERNATIONAL CONGRESS OF PSYCHOLOGY

REPORT OF THE TREASURER:
JANUARY 10, 1928-AUGUST 8, 1930

Receipts:

Dues:

American members	\$8,970.00
Foreign members	1,126.91
	—————
	\$10,096.91
Grant from the Carnegie Endowment for International Peace toward securing the attendance of foreign psychologists	5,000.00
Grant from the American Psychological Association for administrative expense	1,000.00
Interest on bank balances	381.77
Miscellaneous	15.55
	—————
Total receipts	16,494.23

Disbursements:

General administrative expenses:

Executive committee — Travelling and general expenses	\$187.18
Office expenses:	
Treasurer	189.57
Secretary	44.42
Executive secretary	379.91
Foreign secretary	301.99
Program committee expense	445.87
Social arrangements committee expense	654.98
Cost of Psychological Registers	387.71
	—————
	\$2,591.63

Honoraria granted to foreign psychologists	4,702.43
Entertainment	3,157.40

Proceedings:

Editorial expense	\$ 324.17
Printing	2,071.55
Binding	664.56
Mailing	322.43
Aquatints of Harkness Memorial Quadrangle	96.00
	—————
	3,478.71

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Return of dues received in error.....	\$50.00
Return to the Carnegie Endowment for International Peace of the unexpended balance of grant received...	297.57
Transfer of unexpended funds to the American Psycho- logical Association	2,216.49
 Total disbursements	 \$16,494.23

R. S. WOODWORTH,
Treasurer

Audited and found correct: MARGARET FLOY WASHBURN
Audit certified: HASKINS & SELLS, New York, N. Y.

That this record of the Congress may be complete it is desirable to add the following data. The dues for foreign members were \$5, and the dues for American members \$10. The dues included the Proceedings. Foreign members were guests of the Congress for both lodging and board. American members paid \$1 a night for rooms in the Yale dormitories, and had cafeteria rates for meals in the Yale dining hall. Foreign members were guests at the banquet, and American members paid \$3 each for tickets.

It is not practicable to include here expenses of entertainment for foreign members before and after the Congress by institutions other than Yale University. There was entertainment provided before the Congress at Princeton University and Columbia University, and after the Congress at Smith College, Clark University, Harvard University, Wellesley College, and by Professor Warren at Woods Hole. Yale University in its entertainment incurred a deficit of \$3,006.10, for which it was reimbursed by the Congress. A brief summary of accounts of Yale University for entertainment follows:

YALE UNIVERSITY	
<i>Receipts</i>	
Room-rent	\$2,915.00
Dining hall	3,610.66
Banquet tickets	1,320.00
Miscellaneous	55.67
Voted from general funds by the Congress to cover deficit at Yale.....	3,006.10
	 \$10,907.43

<i>Expenditures</i>	
Dining hall	\$4,898.15
Banquet	1,662.00
Rooms and miscellaneous.....	4,347.28
	 \$10,907.43

E. G. BORING, Secretary

PSYCHOLOGY IN INDUSTRY¹

BY MORRIS S. VITELES

University of Pennsylvania

The literature on industrial psychology appearing before 1927 has been reviewed by the writer in two earlier publications (454, 455). In the present article are reviewed publications in this field appearing between January 1, 1927, and June 30, 1930, inclusive. As in the earlier reviews, the policy has been followed of including only books devoted primarily to industrial psychology and articles on the industrial applications of psychology appearing in the technical journals. This arbitrary selection of material has probably resulted in the omission of worthy publications which have appeared in other periodicals.

As in the case of earlier reviews, a special effort has been made to cover completely the German and French literature. There may be a few omissions by reason of the difficulty in obtaining a number of foreign books and back numbers of foreign publications, but the writer believes that these are few in number.

I. THE SCOPE OF INDUSTRIAL PSYCHOLOGY

Recent years have witnessed the appearance of a number of books covering the entire field of industrial psychology and of numerous articles defining its scope and psychological foundations, surveying its general accomplishments, etc. In view of the number of such publications, it seems well to group them in an introductory section of this review before proceeding to a discussion of investigations in the specific fields of vocational selection, merchandising, and of other industrial applications.

Among the major contributions of this sort is a small volume, edited by Myers (287), giving an excellent resumé of problems, methods, and accomplishments in the field of industrial psychology. A chapter by Myers, showing the place of psychology in promoting the welfare of the individual and in increasing production in industry

¹ The writer is indebted to Kinsley R. Smith, a graduate student at the University of Pennsylvania, who assisted in assembling the material for this review.

is followed by chapters on work and environment, work and rest, measurement of vocational aptitude, etc., by investigators in each of these fields. Although reporting almost exclusively findings in English studies, this volume gives a clear picture of the scope of industrial psychology, as viewed by European psychologists, and a broad survey of specific accomplishments.

A more comprehensive treatment of the theoretical foundations, the scope, achievements, etc., of industrial psychology is embodied in a large volume by Giese (158) including a very detailed account of German and other studies on selection, improvement of working methods and conditions, training, prevention of accidents, and of related applications of psychology in industrial life. Of particular interest is the discussion of the contributions to applied psychology, of psychiatry, and of psychological theories,—of the viewpoints of Adler and Freud, as well as of *Gestalt* psychology. It is unfortunate that this valuable book, enriched by many illustrations, should suffer from the somewhat unorganized presentation of material so characteristic of the author, and from an absence of an index and of a bibliography. A somewhat condensed survey of the same ground is included in other volumes by the same prolific author (159, 160, 161). An interesting item in one of these (159) is a calendar showing the outstanding dates in the development of industrial psychology. Freund (140) contributes a sketchy but well written discussion, for the casual reader, of the high lights of industrial psychology, including vocational selection, training, advertising, etc. A text book on industrial psychology is provided by Moede (278).

Among the books not devoted exclusively to industrial psychology, but including a great deal of material from this field, is a volume by Devinat (104) embodying an informative survey of developments in scientific management, and a description of contributions from industrial psychology. This book reflects the association in Europe of two fields of activity exploited by distinct groups in this country. This association, appearing in all major European publications, has been discussed elsewhere by the writer,² and needs no further discussion here. A valuable directory of institutions for the application of psychology and of physiology, and quite complete German and French bibliographies are found in this helpful volume. Equally valuable to the industrial psychologist, although oriented from another point of view, is Poffenberger's (314) comprehensive survey of applied psychology. Findings and methods employed in selection, in

²Viteles, M. S., Psychology in Industry. *Psych. Bull.*, 1926, 23, pages 657-60.

the study and amelioration of fatigue, in the consideration of methods of work, etc., are summarized in this well organized treatise. Less satisfactory are the chapters on the industrial applications of psychology in a book by Moss (283).

The psychiatric point of view in industry finds its expression in a volume by Anderson (11) given over largely to a description of accomplishments in the development of standardized interviewing techniques, the treatment of problem cases, the development of psychological tests, etc., for use in a department store. The volume is a record of definite accomplishment through the application of the "clinical method," in contrast to the "statistical method," in the selection of workers, and in the treatment of individual maladjustment. It reflects, however, the abnormal orientation so characteristic of psychiatry, and the psychiatrist's failure to employ objective methods in the evaluation of specific personnel procedures, as well as his dependence upon the testing techniques developed by psychologists.

Among other volumes of general interest in considering the broader aspects of industrial psychology is a compact and readable summary, by Cathcart (85), of work in England and in the United States, including a bibliography, and books by Chellew (87), Meakin (268), and Nolte (296). An extremely popular treatment of the value of psychology to industry, written in staccato style, punctuated by somewhat lurid and uncritical references to experimental studies, is contributed by Laird (234).

Of historical interest is a new edition of Münsterberg's (286) pioneer work on industrial psychology, including as its only change a supplementary and more recent biography.

The proceedings of various international and other conferences on industrial psychology serve as general guides to recent developments in content, method and changing viewpoints in the application of psychology in promoting human welfare and efficiency in industry. Among these are reports of the International Congresses of Psychotechnique (12, 13), and proceedings of meetings of the International Industrial Relations Association (36, 134).

Among shorter publications on the scope, methods, objectives and theoretical foundations of industrial psychology is a discussion by Lippman (248, 250) of the principles of industrial psychology in the broader study of all the factors affecting productive work by those interested in what the author designates as the "science of work" (*Arbeitswissenschaft*). This relationship is likewise dis-

cussed by Plaut (313). In another article by Lippman (249) is included a survey of human problems in production, and proposals for the systematic examination of such questions as human *vs.* machine factors in production in diverse industries, the importance, among human factors, of individual aptitudes, etc.

The scope of influence upon industrial thought and practice of industrial psychology as science, point of view, and method is outlined by Bingham (60) in a stimulating article incorporating a brief description of agencies in the United States furthering industrial psychology. Methods and points of view of both psychology and psychiatry are contrasted with those of the American exponents of scientific management, by the same author, in a later article (61), in which he briefly summarizes and optimistically evaluates accomplishments in the elimination of fatigue, in the scientific study of employe attitudes, of effects of physical and of social environment. The outlook and accomplishments of industrial psychology are also briefly reviewed by Tread (426).

A somewhat novel and realistic attitude is found in a discussion by Arend (37) of the importance of industrial psychology for European countries in meeting the competition of standardized, high speed American industry. In a somewhat popularly written article on the work of the National Institute of Industrial Psychology (14) is found a further indication of the scope of application of psychology in mending industrial ills. The general social significance of industrial psychology is discussed by Gagg (145).

Theoretical foundations are the chief concern of other shorter publications. Moede (279) outlines the theoretical foundations of industrial psychology. The essential concept of this science, according to the author, is production. The significance of individual genetic and social factors affecting human production must be analyzed, the objective of such an analysis being the formulation of general and specific laws covering human production. Examples include the principle of individual differences, the effect of age upon ability and production, etc.

Viteles (449) stresses the objectivity of the psychological approach in industry, its dependence upon laws of human behavior established in laboratory investigations, its orientation in terms of normal behavior in contrasting the viewpoints of psychology and psychiatry in industry. Brief references to investigations in accident prevention, training, fatigue, etc., are included in this article. The general significance and scope of psychiatry in industry is discussed

by Elkind (125). The definition of psychiatry is made broad enough to include much in the way of method, viewpoints, and techniques described as characteristic of the psychological approach by Viteles (449). Citation of evidence includes, in the main, the work of psychologists, as well as that of Anderson, one of the few active exponents of the psychiatric approach in American industry. Anderson (8) and Smith (376) contribute shorter articles on psychiatry in industry.

In a report of an English symposium (15) on the attitude of employees toward psychological investigations, there are outlined in a general way, the principles underlying the application of psychology in industry, and the distinction between the humanistic character of the psychological approach to problems of industrial efficiency as contrasted with the mechanical outlook of the efficiency engineer.

An article by Kornhauser (217) is given over to a comparison of points of view, organization, and accomplishments of industrial psychology in England, Germany, and the United States. The emphasis in this country on selection is contrasted with European interest in methods and conditions of work. Many facts are combined with judicious observations in this thumbnail sketch of the present status of industrial psychology.

The status of industrial psychology in the United States is appraised by Bingham (62) in an article describing the investigations which have been conducted, and embodying a recommendation for the establishment of a National Institute of Industrial Psychology in the United States to effect a wholesome interaction between the science and industry.

Heller (178) describes the development of industrial psychology in Switzerland, growing out of the early work of Suter, and leading to the establishment of a Swiss Foundation of Industrial Psychology. Vocational selection, the organization of training on a scientific basis, study of methods of work, etc., are included among the activities of Swiss industrial psychologists. A statement on savings effected and a comparison with work in the United States are included in this informative review.

The manifold applications and accomplishments of psychology in industry in England are described in an article on the work of the National Institute of Industrial Psychology, by Myers (288), in a concise survey by Fryer (142), in the annual reports of the National Institute of Industrial Psychology (17, 18, 19, 20), and in annual

reports of the Industrial Health Research Board of Great Britain (33, 34, 35).

A brief description of the present status of industrial psychology in Spain is included in an article in a British journal (16).

A brief description of developments in vocational selection and of investigations of fatigue, effects of temperature, etc., in Japan is incorporated in an article by Yenjiro (478). It is interesting to note that although at the start American influences predominated, there has gradually been a shift toward an acceptance of German concepts and techniques. Agencies for the application of psychology in industry include governmental bureaus, semi-private agencies, etc.

Brief reports on international congresses on industrial psychology are found in American and foreign journals (190, 339).

As a contribution to the history and to the description of the present status of industrial psychology, Baumgarten (48) presents a calendar of dates of the initiation of projects and of publications in the field of applied psychology—with particular reference to industrial applications—as a means of settling to the satisfaction of the author the problems of priority over which the author, among other Germans, has been greatly disturbed.

II. VOCATIONAL SELECTION

1. General

References to the application of psychology in the selection of workers, in some cases taking the form of detailed descriptions of tests, are found in many of the general texts and articles discussed above, under *Scope of Industrial Psychology*. In addition, during the period covered in this review, there have appeared a number of major contributions dealing exclusively or primarily with vocational selection. Among these is a comprehensive survey by Baumgarten (49). The first part of this book is devoted to a dissertation on the foundations of scientific selection, including a discussion of individual differences, the nature and origin of individual aptitudes, interests, etc. This is followed by chapters on job analysis, classification of occupations and principles and techniques in the development of selection tests. The major portion of the book is given over to a detailed review of procedures which have been developed in Europe and in the United States for selecting workers in diverse occupations. In the case of each, the author includes a description of the tests and of results which have been obtained. A bibliography of 1,200 titles completes this imposing work. The volume is invaluable.

able by reason of the richness of its contents, in spite of occasional errors with respect to individual—particularly American investigations—and the expression of bias rather than of judgment in distinguishing among investigations with respect to practical significance and scientific value.

A description of tests used in selection for clerical and mechanical occupations is included by O'Connor (298) in a volume teeming with aesthetic judgments and with what are virtually metaphysical speculations on the nature and origin of aptitudes and of individual differences in aptitudes. The book is a curious combination of carefully presented data representing real accomplishment in the selection of workers for a few specific occupations, by one essentially unversed in the refinements of validation, and of unwarranted assumptions and conclusions in the fields of biology and psychology. Not the least serious of the metaphysical excursions is a series of vocational prescriptions for young men and women based on tests and standards developed in specific industrial situations.

Among other publications primarily devoted to vocational selection is a second edition of Laird's book on the psychology of selecting men (235), and a consideration by Schindler (351) of the significance of vocational selection from the viewpoints of scientific management, of social and political welfare, which includes a description and discussion of private and governmental agencies employed in this work.

Among volumes not exclusively devoted to the use of psychological tests and other scientific selection procedures in industry, but having an important bearing from the viewpoint of industrial application, is a book by Hollingworth (189) combining material from two earlier volumes on the use of the letter of application, the estimate of character from photographs, phrenology, the interview, psychological tests in the measurement of mental competency, the significance of interest, intelligence, etc., and including an appendix of laboratory exercises and a bibliography. The chief significance of the volume is *historical*, in the sense that it carries the reader back to earlier investigations of subjective and objective methods of character analysis for vocational purposes, and *critical* in its emphasis on the practical usefulness of subjective methods. The failure to include reference to very important recent work in the measurement of vocational aptitude seriously limits the usefulness of this book, as interesting as it may be as a reference work, and as

a link with the beginnings of vocational psychology by one who early gave his attention to its problems.

Somewhat in contrast to Hollingworth's book, from the point of view of immediate serviceability to the industrial psychologist interested in the development of selection tests, is Hull's (196) volume on aptitude testing. The clear and highly critical discussion of the nature of aptitudes, the comprehensive treatment of procedures, cautions, and statistical methods in the construction, calibration, and validation of aptitude tests, and the illustrative material make it an invaluable aid in the practice of industrial psychology, and in the appreciation of the theoretical foundations and techniques of aptitude testing. Among other publications which, although in no sense limited to vocational selection, are of distinct interest to those dealing with vocational selection, is a volume devoted to the history, theory and description of mental tests by Freeman (139). The critical attitude of the author makes it helpful in understanding the uses and limitations of tests. In the same way, a discussion by Wells (466) of the use of mental tests in clinical practice embodies comments on testing procedures and the limitations of psychometric measures which should be known to the industrial psychologist. A manual by Bronner, Healy, Lowe and Shimberg (76), containing descriptions of procedures and norms for many standard tests, descriptions of tests by Drever and Collins (113), and a discussion of the use of tests in an experiment in vocational guidance by Earle, Milner *et al.* (119), represent useful additions to the library of the industrial psychologist.

A number of shorter articles and manuscripts are devoted to underlying *theory in test construction and standardization* and to *administrative problems* in the use of tests for the selection of workers. Rupp (340) discusses the theory and practice of psychological testing, stressing the importance of exact objective units of measurement, of qualitative observations and of the consideration of the influence of practice and conditions of administration, etc., in the measurement of vocational aptitude. The complexity of the selection and guidance problem is pointed out by Wallon (457), who refers to studies showing the significance of such factors as interest, the influence of heredity and environment, etc. There is included a brief discussion of the possible application of psycho-analytical techniques and viewpoints—particularly of Adler—in discovering the obscure tendencies which motivate the individual in occupational life. Marbe (263) distinguishes between "psychological aptitude",

which appears in a test performance, and "vocational aptitude", based on the former, but reflecting training.

Hanna (174) sketchily outlines the steps to be followed in the standardization and validation of tests of vocational aptitude. Kitson (209) pleads for a comparison of scores on a single test of workers in diverse occupations, and for the comparison of scores made by vocationally selected and unselected groups as necessary steps in the development of tests, if they are to be useful in the selection or guidance of individuals with mediocre vocational aptitude, as well as of the highly superior. The viewpoint, whatever merit it may have, is, of course, less applicable in selection, in which interest may legitimately center on the extremes of a distribution, than in guidance. The steps to be taken in the calibration and validation of selection tests are also discussed by Lahy (230), who, unfortunately, uses as an illustration the validation of a test of bi-manual coördination on a total of five "Good" and five "Poor" operators.

Stern (409, 410) stresses the global character of personality in discussing what he has termed "personalistic" psychology. Of special significance, with respect to the construction and use of tests is his criticism of the analysis of human behavior into so-called functional elements, and his insistence upon the development of selection tests resembling the entire activity in which the individual is to engage. Juhasz (203) follows Giese and Stern (409, 410) in a demonstration of the importance of viewing the total personality of the individual, in contrast to a mosaic of independent elements, in the prediction of vocational attainments. The approach reflects the influences of a *gestalt* viewpoint in psychology as applied in the measurement of individual differences.

The relation of vocational testing to Spearman's two factor theory is discussed by Earle (120).

Objections to the use of psychological tests in selecting workers are voiced by Sotomin (385) in an article describing the work of a Russian institute for the application of psychology in industry. Among the most interesting of these objections—if not the most reasonable—is that based on the view that occupations seldom require the development of specialized abilities above the level attainable by the average individual. This viewpoint parallels the very general assumption of Kitson (209) that 50 per cent of the population will succeed with a 50 percentile degree of success in 50 per cent of occupations. Other theoretical considerations pre-

sented as arguments against an undue insistence upon careful selection include the greater significance of general, as compared with special ability, the infrequent occurrence of specific defects, etc. The increased mechanization of industry is cited by Lippman (251) as a factor which will result in a decreased need for highly specialized selection tests.

Problems in *statistical treatment* are the burden of other articles of interest from the viewpoint of theory in vocational selection. The importance of recognizing psychological dangers and limitations in statistical methods is discussed by Myers (289), who refers specifically to the use of certain of these measures (correlation and reliability) in connection with the validation of vocational tests. Kitson (209) objects to undue emphasis on correlation techniques in the validation of tests in vocational selection and guidance. Critical comments on the calculation of correlations are included in an article by Rupp (341). A comprehensive discussion of frequency curves, with particular reference to the significance of each of six types in the calibration and validation of tests as well as in other psychological research in industry, is contributed by the same author (342). Lazarsfeld (242) discusses the normal distribution curve from the viewpoint of tests used in the measurement of production. Frequency curves in industry are also discussed by Lehmann (243).

A method of treating test results to permit the combination and scoring of the two variables speed and accuracy is suggested by Lahy (231). Strong (416) compares formulae used in arriving at weights for scoring an interest inventory.

A problem of *administration* is touched upon by Dixon (107), who makes the discovery that psychologists are adopting the viewpoint of psychiatrists in insisting upon more than test scores as employment criteria. The author appears to be ignorant of the technical literature on the use of tests, and of the historical background and viewpoints of clinical psychology. The limitation of test scores and the importance of a supplemental psychiatric analysis are also discussed by Ray (335) and by Hubbell (195). The latter rates aptitude as having a weight of only 25 per cent in vocational proficiency; attitude, training, and supervision accounting for the remaining 75 per cent. On the basis of this analysis, the relative importance of selection tests, as compared with the psychiatric interview, is discussed. There is the failure, characteristic of psychiatry, to present objective data to substantiate the generalizations on the

administrative limitation of testing techniques, and on the validation of other methods. The relation between the psychological testing laboratory and the employment office in the administration of tests is discussed by O'Connor (299).

Findings from *follow-up* studies and general problems of *validation* are considered in a number of articles. Roloff (331) reports on a very thorough validation of tests used in the selection of apprentices for the metal trades. Twenty-eight tests were applied to 34 apprentices divided into three groups, carefully selected by foremen with respect to character of work, from among a great number of employes. The contribution of each test, the comparative value of objective and subjective judgments, the relation between the length of each test and test validity, the relation between the number of tests and the validity of the battery, are carefully studied and judicious conclusions drawn therefrom. This study represents one of the most careful evaluations in a field in which many hasty conclusions have been drawn. Bramesfeld and Taubeneck (70) also report an unusually thorough study of a large battery of tests, of the analytic type, used in the selection of apprentices. There are discovered marked differences in reliability among the tests—the so-called sensory tests showing, in general, lower reliability than tests of motor ability and of general intelligence. This is also true in the case of validity. This follow-up of test results is considerably weakened by the small number of subjects—only 12 in the case of some tests—and by a highly unsatisfactory criterion, but it is outstanding among investigations in this field in recognizing the significance of a careful study of reliability and validity and of follow-up in the development and use of selection tests. The validation of a battery of vocational tests is also discussed by Biegeleisen (59).

Ruffer (337) reports satisfactory correlation between pre-employment test scores of 104 workers and curves of daily production of lamps. The objectivity of the criterion—a characteristic which still appears all too infrequently in selection studies—adds to the significance of his findings. In a comparison of pre-employment test scores with the work records of 131 apprentices who had completed a four year apprenticeship, Heilandt (176) finds a confirmation of the validity of the tests. The criterion is a complex of ratings by supervisors, final examination grades in an apprenticeship school, and scores on a work examination.

Skaggs's (370) comments on validity, in a discussion of prevailing concepts in mental tests, applying to industrial testing, in which

subjective criteria have been so frequently employed. Bramesfeld (71) considers the difficulties experienced by foremen and supervisors in making judgments on the accomplishments of working personnel.

Provisions for the application of selection tests are reviewed in a few articles. The plan of organization of a testing service with decentralized branches is described by Couvé (91). Payne (304) describes tests used in the selection of workers, and refers to agencies engaged in developing and giving tests in a highly uncritical discussion of how workers are tested in Germany. The extent to which vocational selection tests are used in Germany and Holland is briefly reviewed by Prak (322). The status of vocational selection in Hungary is summarized by Sandor (347). Heydt (197) contributes a brief description of the scope of scientific selection by the State Railways of Germany, in connection with which there are 27 centers applying tests for aptitude in many types of work. The development of scientific methods of job analysis and selection under the auspices of the United States Civil Service Commission is sketched by O'Rourke (302) in an article including samples of a few tests. Significant from the viewpoint of the broader application of tests is the program recommended by the author for the coöperation of industry, schools, and the Federal personnel service in making available the results of standardized tests, developed by coöoperative research, for purposes of guidance of the individual, as well as for selection in diverse industries.

General problems in the measurement of *temperamental* or *personality* traits continue to occupy the attention of industrial psychologists. Bathurst (47) discusses the importance of temperamental traits in vocational adjustment and furnishes specifications of social characteristics for various jobs in the form of scores on a Diagnostic Temperament Test. In contrast to his buoyant confidence in the scores on temperamental tests is Baumgarten's (50, 51) recommendation for the exercise of caution in the judgment of character on the basis of tests. Couvé (92) also warns against the uncritical use of so-called tests of character in vocational selection, and points to the possibility of making observations of such traits as endurance, will, etc., in the course of performance on aptitude tests. Reference is made by Schmitt (352) to the existence of character types in industry. A disregard of fundamental principles in character measurement is reflected in the publication of a presumably universal test of honesty (21).

Earlier experiments and conclusions on the relationship between *interest* and *ability* are summarized by Fryer (143), who draws the conclusion that vocational interest is not a significant criterion of vocational aptitude. Kitson (210) asks teachers and nurses to rate themselves on interest in their profession, on a rating scale embodying a highly imaginative criterion. From an examination of interest of these workers in their occupation he draws highly questionable conclusions concerning the significance of interest in vocational adjustment. Further experimental results on the place of interest in vocational adjustment are presented by Strong (417).

Among miscellaneous specific problems relating to the use of tests in vocational selection are reports on investigations of the relation of age to test performance. Ehinger (122) reports a preliminary study of the effect of age on performance on 5 tests involving the examination of 181 workers, 22 to 50 years of age, with from 7 to 31 years of experience in a factory. The findings reveal superior test performance on the part of younger employes, a superiority which also appears in production. A similar investigation by Weiss (465) in the case of railroad employes leads to similar findings. The latter expresses the opinion that (1) a diminution of ability to adapt oneself to a new situation, and (2) a deterioration of intellect explain the decrease in efficiency with age in certain of the tests employed in this study. The findings of Glasel (163) with respect to the general trend and to the variation among individual tests confirm those of Weiss (465).

2. *The Measurement of Motor Capacity in Industry*

The general problem in vocational selection which appears to have received particular consideration during the period covered by this review is that of the measurement of what has been designated with the various names of *motor ability*, *skill*, *manual aptitude*, *motor capacity*, etc. A number of first rate contributions on the nature of motor capacity (to adopt one of the names) and on measurement techniques have appeared. In view of the very general significance of this problem, it seems well to discuss these contributions together, although findings on the prediction of proficiency in specific occupations are to be found in a number of these studies. A brief reference to the latter will be made under appropriate captions below.

The discussion of this problem, as it has been treated in the literature, entails a consideration of the controversy on the relative

suitability of the "analogous" and "analytic" types of test, and leads, in a few instances, to reference to what are virtually experiments on learning.

The ambiguity of terminology in this field is referred to by Pear (306, 307, 308), who defines *skill* as an integration of well adjusted performance—a pattern of performance characterized by complexity, integration, and adaptability to changing situations, the aptitude for which is based upon well coördinated reflexes, instincts suitable to the task, adaptive habits, and the power, or maybe powers, of patterning. In this sense, there may be mental, executive, social, as well as hand skills. Pear's discussion is largely centered around the latter. Distinctions are drawn among *capacity*, based on inherent mechanism, *ability*, representing a level of functioning determined largely by practice, and *habit*, representing efficiency in a specific operation. The importance of an analytic study of the kinds of skills required by industry is pointed out, and a tentative classification of industrial skills is offered. Pear's treatment of this basic problem—his integration of material from laboratory investigations on habit formation, the transfer of practice, the measurement of differences in so-called psycho-motor traits, and facts of an economic order—is thought provoking. At the same time, although the importance of his contribution is undeniable, it is questionable whether his treatment satisfactorily clears up the ambiguity of terminology and the befuddled thinking on this subject about which he complains.

As Pear points out, there is need for systematic experimental investigation of concepts and theories on the nature and measurement of the so-called motor capacities as one factor in certain kinds of skill. Such a systematic experimental approach is employed in a unique study by Fairchild (128), who adapts the Gilbreth motion study technique to the study of skill (as defined by Pear) of 75 workmen employed on 11 types of machines in 4 plants. The findings (embodying case studies of individual workers to be reported in detail in a later article) indicate that where skill exists, and is given play to a considerable degree, it tends to become a first and greatest source of satisfaction to the worker, and that specialization of work may certainly be associated with lessened skill in workers. A summary of viewpoints on the nature of skill, and a bibliography on skill and mechanical ability are included in this excellent article, the implications of which cannot be neglected by those interested in the measurement of motor capacities.

Pear's point of view is also reflected in an investigation of "manual dexterity" by the National Institute of Industrial Psychology, reported by Earle, Gaw, and others (121). Although the subjects are children between the ages of 12 and 17, 1,000 in number, the findings and conclusions are significant from the viewpoint of vocational selection. The word dexterity is used to mean precision in the control of movement, or speed in the repetition of a movement, or both in combination, the dexterities representing the habit forming capacity of the individual in respect to bodily adjustments, as distinguished from skill, which involves their effective application in some particular task. The investigators distinguish between "manual dexterity" and the general factor of "motor ability" which has been assumed to underlie bodily activity. The investigators recognize as an important aspect of the study the question as to whether the skill of an individual at any given step of development is a reliable measure of his habit forming capacity. The report embodies an analysis of the tests used, a wealth of statistical and other data, and conservative conclusions with respect to sex differences, reliability, age differences, differences due to training, etc. The study of the inter-correlations brings out a high degree of independence of abilities, measured by them, when Spearman's tetrad difference criterion is applied to the table of correlations, the factors determining success in each appearing to be specific to the test situation. However, the fact that tests may be grouped to show higher correlation between themselves than with those other groups may be taken to signify the presence, rather than the absence, of group factors. The weakest conclusion, although stated in very tentative form, is one on the possible usefulness of certain tests of dexterity in selecting best trainees for an occupation, based on a correlation of test results with the very unsatisfactory criterion of teachers' estimates of proficiency in manual occupations.

Farmer (129) reviews the positions of Perrin and Muscio and discusses the intercorrelation of a group of "aestheto-kinetic coöordination tests". The author points out that when grouped, a common factor seems to appear, and concludes that further experimentation may definitely reveal group factors in sensory-motor activities. However, he agrees with Muscio and others that vocational tests should be specific to the situation. In another article, the same author (130) discusses the results of 1,342 subjects, divided into 8 groups, on choice reaction tests, involving 30 stimuli. Curves showing average time of each stimulus for each group are parallel,

as is also the case, according to the author, with results of psychological tests of a motor order used in industry. It must be observed that the averaging of scores of large numbers obscures the individual differences in curves to which other investigators, as, for example, Robert (329) attach great significance.

A résumé of the more important work on the measurement of motor capacities is contributed by Seashore (368), who also describes an investigation in which 8 tests were applied to 50 University students. Data on reliability, on the effects of practice on the motor activities, correlations among the tests, etc., is given. The results confirm those of other studies in showing a consistent, although low, positive correlation among most motor tests. The author suggests that in job selection, a sampling of serial performances of the same general motor-skill coöordinations involved, would be the most likely device for predicting a practical "motor-skill". The Stanford Motor Skill Unit, a battery of tests for experimental work in this field, is described in other articles (369) embodying additional findings with respect to these tests.

Recommendations for the use of work curves on simple operations, in preference to tests of the "analytic" type, in measuring motor capacity and in predicting proficiency in manual operations are found in the publications of other investigators. European psychologists seem to be divided into two distinct camps on this question—with Moede and Piorkowski in Germany carrying the banner for the "analytic" tests, and with Poppelreuter and Giese waging the war for the work curve. In a statement of his viewpoint Poppelreuter (318) criticises the prediction of vocational proficiency on the basis of a few tests of short duration, and insists that a prognosis should be made only after an examination lasting for more than an hour and involving a performance resembling closely that of the work itself. He cites examples of tests, involving in one case simple and monotonous manipulations in placing balls into apertures; in another case, attention in finding boxes marked with characteristic signs, etc. Work or practice curves, recorded automatically, are analyzed to show errors in diagnosis and prediction of proficiency on the basis of performances of short duration.

Experimental investigations of the practice curve as a selection device have, in practically every instance, involved a measurement of motor capacity and a prediction of motor proficiency. Learning factors have naturally been considered in this connection. So, for example, Gemelli (156) presents a critical survey of the concept of

manual ability and arrives, on the basis of an experimental analysis, at a definition of "manual ability" in terms of a fixed form, or *gestalt* of movements through practice and associated with the adaption of each movement to a specified end. His experiments lead him to favor the conclusion that the diagnosis of manual ability, as, for example, in the case of applicants for apprenticeship, should be based upon an examination of work curves, rather than upon "analytic" tests of specific traits. Incidentally, he suggests the desirability of using work curves obtained during the early period of training in preference to those obtained prior to employment, on performance simulating the occupation. In another article by the same author (157) is a brief review of the literature and a description of an experiment involving spinners and operators of lasting machines in a shoe factory, the results of which lead to similar conclusions. The findings agree with those of Argelander (38) on the relation between performance during the first part of a working period, and the effect of practice in decreasing individual differences in production, etc. The greater effectiveness of practice on the work itself, as compared with practice on an analogous task, is suggested by the results of a study by Langdon and Yates (239), which indicate that in manual dexterity and visual discrimination the effect of training is specific rather than general.

A critical evaluation of the work sample method recommended by Poppelreuter (318), partly on the basis of an experimental study, is included in an article by Winckler (469). The author disagrees with the insistence of the former upon complete liberty to the subject in carrying on his work. He also finds in the work sample situations incentives similar in part to those found in the work test. The author points to the desirability of supplementing work samples with tests measuring traits not subject to examination by work samples. He also recommends qualitative analysis in the case of both work samples and tests. The use of work samples is also urged by Baurmann (52), following an experimental investigation of differences in rate of work on a drill press.

Sollier and Drabs (383) employ reflex movement of defense in examining the influence of training on success with a simple motor act. They confirm the findings of Argelander (38) and others concerning the failure of those starting with a poor performance to reach the level of the best. The investigation is oriented from the point of view of selecting workers. Another investigation by the same authors (384) leads to the conclusions, with respect to

absolute speed, that the highest limit of performance, when the plateau is reached, can be considered as an index of perfectability; that the order of subjects established at the beginning of practice hardly varies, etc. It is found, however, that the same rules do not apply when precision is combined with speed. The results suggest that, contrary to common opinion, trainability in precision does not depend upon perfectability in speed. However, the conclusions, obtained on 10 subjects with a somewhat limited time for practice, may be considered as tentative. Robert (329) studies the practice curves of two groups of ten apprentices in 5 operations, including bi-manual coördination, perforation of a paper band, etc. His findings lead him to stress the importance of studying the work curve of the individual, showing the nature of his trainability and adaptability, in vocational selection. Ehinger (123) reports an important investigation on the effect of manual work upon performance in 4 tests of manual ability. The subjects include (I) 25 students in a pre-apprentice class, tested during the first week of apprenticeship, and again after a lapse of 5 months; (II) 88 workers, aged 14 to 30 years, tested prior to employment and after 3 months to a year subsequent to employment; (III) a control group of 54 pupils of the same age as the apprentices, and (IV) adult workers employed in a factory for at least 7 years, examined twice at 3 month intervals. The author finds that the second test performance is in every instance superior to the first, but that the children in the control group show less improvement than the apprentices, although retested after a shorter interval. There is relatively more improvement in the case of those testing low on the first performance than in the case of those testing high. Although a control group of adults would have been desirable, these and other findings in the study are of significance in view of the meagerness of direct experimental evidence on the effect of practice on a manual occupation upon performance on tests of motor capacity. Wallon (458) Kellner (206), and Erschowitz (127) also contribute discussions on the type of tests to be used in the measurement of manual ability.

The fact that there is no universal dissatisfaction with the "analytic" type of test for the measurement of motor capacity is reflected by the publication in recent years of a number of articles describing such tests, and furnishing more or less statistical data on their validation. The Minnesota Mechanical Aptitude Tests are described and discussed in an article by Anderson (6). Stoy (414, 415) describes a series of tests which are compared with instructors'

ratings and with independent ratings on a group of mechanical drawings. The author draws conservative conclusions on the possible usefulness of these tests in measuring traits involved in mechanical drawing, and in other forms of motor skill. MacQuarrie (261) describes a paper and pencil test of mechanical ability, and offers very inadequate evidence of its validity. Evidence of similar value on this test is included in an article by Stein (408). The "wiggly block" as a measure of mechanical aptitude is discussed by Keane and O'Connor (205) whose figures show that the test distinguishes between mechanics and draftsmen as compared with an unselected group. Schultz (361) describes a test for motor capacity involving bi-manual coördination. A detailed analysis of coördination and descriptions of procedures for its test measurement, are included in a monograph by Meistring (271). A scale of tests for measuring motor capacities involved in gymnastic activities is described by Brace (68). A volume by Schulte (358) includes material on the measurement of motor aptitude for athletic games.

3. *Specific Occupational Tests*

A. *Tests for Skilled and Semi-skilled Workers.*

In the investigations of aptitude for factory work Europe, and particularly Germany, still continues in the lead. A number of the studies to which reference has been made in the discussion of books and articles of interest from the standpoint of general problems in selection embody findings referring specifically to the selection of skilled and semi-skilled workers. Among these are the publications by O'Connor (298), Roloff (331), Kellner (206), Bramesfeld and Taubeneck (70), Ruffer (337), Heilandt (176), Fairchild (128), Gemelli (157), Baurmann (52), Poppelreuter (318), Robert (329), Erschowitz (127), Keane and O'Connor (205).

Additional contributions on selection for occupations requiring skilled and semi-skilled workers include a number dealing specifically with metal trade apprentices. In an article by Kellner (207), is found a brief history and description of procedures used in the selection of apprentices in the metal trades of Berlin. The author employs an ingenuous procedure to show that, on the whole, suitably selected apprentices can be expected to be 15 per cent more efficient than those haphazardly selected, at a gross saving of three hundred marks over a four year apprenticeship period. Lahy (232) follows a verbose discussion of changes in the aptitudes of apprentices imposed by the introduction of machines with a brief description

of an investigation involving a comparison of the test scores of 53 apprentices with the accomplishments in academic subjects and in the work shops of an apprentice school. Anderieth and Rupp (41) contribute a detailed description of procedures employed in the administration of group and individual tests in the selection of machinist apprentices for the work shops of the Austrian Railways. In spite of the absence of correlation between test results and plant production, satisfaction is expressed with the tests by reason of improvement in related school work and because of the better impression made upon foremen by those tested prior to employment. Luithlen (259) contributes a brief survey of the present status of apprentice selection in a large German industry. Validation data for the tests referred to by this author are included in an earlier article by Heilandt (176).

A special study of tool making apprentices forms part of a general investigation of intelligence tests for employment, reported by Pond (317). Eight tests and a personal history questionnaire are given to three groups of apprentices. Each test and a combination of the most significant of them are compared with foremen's ratings, and a preferred range of scores established. The percentage of satisfactory workers in the preferred range of total scores is 82 and in the non-preferred range, 23, while among all apprentices tested, it is found to be 60. Use of these tests reduced the number of unsuitable apprentices among those hired, from 18 per cent to 0.

The general investigation by Pond (317) includes an evaluation of the same eight tests and of personal history items in the selection of workers for 65 occupational groups in a brass factory. The methodology is such as to give preferred ranges on individual tests and items, and on combinations of tests, which permit every applicant to qualify for one or more positions in the plant. This study is of unusual scope from the points of view of objective, of number of workers examined, of the periods covered, etc., and involves a painstaking analysis of criteria of reliability, and of the reliability and validity of individual and combination tests. It is characterized throughout by a highly conservative and judicious attitude in the interpretation of data and in the formulation of conclusions with respect to the usefulness of the tests, etc.

The validation of twelve analytic tests for use in the selection of workers and apprentices for foundry work is described by Bültmann (79).

A variety of factory occupations is included in a study by Walther

and Ehinger (459), also described in separate articles by Walther (460, 461), who find a correlation as high as + 1.00 between ratings of 230 workers engaged in 11 departments of a food product plant, on five tests of motor ability. An uncritical use of correlation methods and a disregard for certain contradictions which appear in the results temper the scientific value of this study. Heilandt (177) describes a battery of analytic tests and administrative procedures employed in the selection of workers for a number of specialized factory operations involving intensive training. The results of a preliminary follow-up are included in the article.

Various methods employed in the selection of metal trade workers are compared by Toltchinsky (433), who criticises the assumption that it is possible to use a single series of tests for an industry including over 100 specialized activities, each of which is characterized by highly diverse operations.

Among articles on other factory occupations is an analysis of acetylene welding and an investigation of selection tests for this work by Radler (326). An analysis of the qualifications of crane operators and a preliminary evaluation of tests of competency for this work are included in an article by Oberhoff (297). Tests for glass blowers are described by Bolt (66).

The aptitude of printers has been the subject of other investigations. Taylor (424) finds differences in average intelligence test scores of pre-apprentices, compositor apprentices, and press apprentices. In a more extensive investigation by the same author (425) seven tests are applied to approximately 800 apprentices, including 40 hand compositors, 70 linotype operators, 50 stone hands, 110 job and cylinder pressmen, 145 newspaper pressmen, and to 800 pre-apprentices. The test scores are compared with the rather uncertain criteria of ratings by instructors in the apprentice schools, with performance on job samples, etc. The findings are viewed by the author as helpful in envisaging the problem of printing aptitude, which requires much more complete analysis. Hall (172) reports a correlation of + 0.58 between the Minnesota Paper Form Board Test and ratings of from "Poor" to "Exceptional" by instructors of 89 apprentices attending a school for printing pressmen. Although there is the usual difficulty with the criterion, the results are of interest in confirming the reliability of the test and in connection with the general findings included in the article by Taylor (425). Christaens (89) describes a re-evaluation of tests for printers, revealing differences between "Good" and "Poor" workers.

In a study of 341 apprentices in the hand sewing trade, Stolley (413) administers seventeen tests and compares test scores with an objective work task of preparing clothes for a doll and with general trade achievement.

Michalewa and Kujawesa (275) describe the evaluation of twenty-four tests for machine and hand workers in a tailoring plant. Satisfactory correlations are reported in the study of 57 apprentices divided into three groups on the basis of ratings by the supervisor of apprentice training. Eighteen tests are used by Treat (437) in an attempt to predict the ability of subnormal girls to operate power garment machines. Five of these show a correlation of +0.66 with the criterion of "probable success," this correlation being higher than between chronological age, mental age, or I.Q., and the criterion.

In the textile industries, Schneider (354) employs Poppelreuter's method of analyzing work curves in predicting the success of workers in a silk mill. The study is of particular interest from the viewpoint of methodology, involving an analysis of the job by time study techniques. Lewin and Rupp (245) describe the evaluation of tests for operators of spinning machines and for dressmakers.

Tests of bookbinders are described by DeCroly (117).

Electric substation operation is investigated by Viteles (450), who includes in his article data on the validation of selection tests by comparison with the working efficiency of substation operators, senior operators, and assistant operators. Both an objective criterion of operating errors and a subjective criterion of ratings are employed.

The Bureau of Public Personnel Administration makes its contribution to the quota of unstandardized and unvalidated tests in the form of suggested tests, generally combining trade and aptitude tests in paper form, for farmer (398), baker (399), steam fireman (23), instrument men (24), head laundry man (387), rod man (25), laborer (277), blacksmith (388), water meter reader (389).

B. *Tests for Office Occupations*

Among contributions on tests for office occupations is a survey by Freyd (141) of tests of aptitude, proficiency, and education, which have been used in the selection of typists and stenographers. Data on the evaluation as well as descriptions of the tests are included. Somewhat the same information for fourteen tests of clerical ability is included in an article by Anderson (7) which closes with pertinent critical remarks on these tests.

The predictive value of general intelligence tests in the selection of junior accountants and bookkeepers is discussed by Scudder (367). The subjects of the investigations are rehabilitated war veterans. General relationships between general intelligence and degree of rehabilitation in these occupations are revealed. Data obtained in a comparison of scores on standard tests of proficiency and of aptitude with progress in typewriting, reported by Stedman (407), are of interest from the viewpoint of the use of these tests in selecting typists.

Trade and ability tests are included in batteries of tests for use in selecting workers for clerical occupations in an investigation by Munro and Raphael (285). The number of cases is small in every instance, and only in the case of Hollerith operators is an objective criterion employed. Reference is made to tests for six other clerical occupations. Low correlations between grades on an achievement examination and psychological test scores on one hand, and supervisors' ratings of 200 office employes on the other hand, are reported by Braunshausen (73). The author explains the low correlations in terms of the failure of tests to measure character traits. Weigl (463) contributes an article on the validation of six tests in comparison with ratings of fifty-two office employes of a Dutch commercial firm. The tests are of the analogous type, specific to work situations.

Tests for Hollerith machine operators are described by Couvé (93).

In an article by Dixon (108), procedures employed in the selection of cashiers are reported. Psychological test scores and personal data obtained in a clinical interview are combined to give "satisfactory" results. However, the author's assurance that the procedure gives "good results" represents the only reference to validity.

A further contribution to the already long list of tests without known validity in the selection of office workers is made in the form of suggested tests for stenographer (390), secretary-stenographer (26), statistician (391), senior statistical clerk (392), senior file clerk (393), senior clerk (394), addressograph operator (27).

C. Tests in the Selection of Transportation Employes

Little progress in the development of new tests for transportation workers has been made in recent years, attention being centered on the re-evaluation and critical comparisons of existing techniques. A section of a comprehensive volume by Herwig (181) is devoted to tests for operators of all types of motor vehicles. The description of Münsterberg's work is followed by descriptions and highly critical

evaluations of techniques employed by Faust, Moede, Piorkowski, Tramm, those used on German railways, etc. A section of this book is given over to a consideration of the tests used in the selection of other transportation workers such as yardsmen, transportation supervisors, etc. A similar review of investigations in the selection of motor vehicle operators is embodied in an article by Hallbauer (173), representing a source of much valuable information to those interested in this field. Among tests classified by the author as analytic in character he discusses and critically evaluates the tests of Moede, Piorkowski, Tramm, Viteles, Lahy, etc. Among synthetic or analogous techniques, involving an attempt to measure the global situation, he includes the tests of Rupp and Stern. Tests of proficiency of speed are treated separately. The reader may disagree with Hallbauer's classification and with his critical comments, but these are mere details in this relatively short but thorough review of experimental studies in the selection of operators for motor vehicles.

A full description of tests of speed of reaction, distribution of attention, mechanical ability, judgment of speed and distance, etc., used by Lahy in the selection of motormen are described in a volume by this investigator (233). An analysis of the job and of the qualities presumably measured by each test, detailed data on procedures, on distribution of results, on the scoring of each test, etc., are included. Validation data are reported for 200 men with a criterion which has not received the same careful study as it has been given, for example, by Shellow (371). The practical usefulness of the test appears in a statement by the director of the transportation company that only 3 per cent of employees are found unsuitable to employment, in contrast to the 20 per cent before the tests were used, and that great economies in training cost and accident cost have resulted from the use of these tests.

A new test for the selection of motor vehicle operators is described by Forster (136), who insists upon the importance of time of choice reaction to various sensory patterns in safe driving. The author notes a relationship between success in a choice reaction test and general intelligence. He also suggests that tests of intelligence, reaction time, and span of sensory perception can replace every other kind of special examination for drivers. No validating data is presented to bear out this conclusion.

Johnson (200) quotes Snow and Wechsler in recommending a mental age of twelve years as a qualification of safe driving. Snow (380) finds greater turnover at the end of a month among men

with low scores on a general intelligence test than among others. A reference to tests for cab drivers is found in another article (381) by the same author.

Of significance from the viewpoint of the selection of motor vehicle operators is an analysis by Kunze (228) of factors which intervene in perception of speed of movement. He tests the visual factor as reflected in estimating the speed of movement of images projected upon a screen; auditory factors by discrimination of differences in tones of a moving motor; control of equilibrium, etc. He then submits each of twenty-six subjects to a complex global test of a perception of speed of movement such as occurs in a moving automobile. A correlation of + 0.89 between the auditory test and the global test leads him to the somewhat premature conclusion that the auditory factor is the most important in estimating the speed of a moving vehicle. Dembitz (103) also reports an investigation on the visual perception of movement.

A small electrically driven motor and a test requiring the subject to follow a printed path on a moving belt are used by Poppelreuter (320) to study tendencies in the operation of a motor vehicle. Among the types of operators isolated in this study are the "reckless," the "anxious careful" type, the "differentiated careful," etc. Apparatus used in this investigation, embodying the work sample viewpoint of the author, is recommended for use in the selection of operators.

Shallow and McCarter (371) describe an improved method of rating for use in rating the operations of a motorman to arrive at an index of his proficiency.

D. *Tests for the Professions, Engineers, Executives, Etc.*

The total absence, during the period covered by this review, of technical publications in English on the selection of salesmen, suggests a lack of interest in a phase of selection which received considerable attention a few years ago. The problem of selecting salesmen is attacked in a few German investigations. Müller (284) finds a correlation of + 0.65 between five tests and ratings of sales people. The number of subjects and other pertinent data are omitted from the report. Moede (280) describes another battery of tests employed in the selection of retail sales apprentices and presents an equally unsatisfactory report on validation. Bogen (65) passes in review the problems entailed in the development of scientific techniques for the selection of sales personnel. Difficulties in the analysis of quali-

fications, of providing suitable criteria, the importance of character traits, etc., are discussed. Stern (411) also contributes a brief exposition of principles and refers to investigations in selection of employes for mercantile establishments.

A specialized phase of selecting is made the subject of investigation by Wagner (456), who employs technical problems and measures of intellectual capacity in the selection of sales engineers in the metal industries.

Strong (418) reports further data on the interests of engineers, and suggests the possible use of the Interest Inventory, with revised scoring, for the selection of engineers for the electrical industry. The interest of engineers as compared with other occupations is treated at length in another article (417). The question of the validity of these tests for predicting engineering ability remains unanswered.

Remmers (328) develops another interest inventory to distinguish between students interested in engineering and those interested in agriculture. The inventory is open, as the author recognizes, to the same questions concerning purpose, reliability, validity, serviceability in selection, and guidance, as are other tests of this type. A brief review of interest measurement and a bibliography are included by the author.

Strong (419) applies his Interest Inventory to eighty executives and analyzes similarities and differences of interest in comparison to those of men in allied professions. His results lead him to question the possibility of using the inventory to isolate executives as a distinct group. The author discusses the hypothesis that there exists a class of executives as distinct from other occupational groups. The Allport A-S, C-2 Personal Inventory, and a Directions tests are used by Beckman and Levine (53) in an attempt to find a test of executive ability. Only the first shows any sign of validity in a specific situation involving city executives, ratings on efficiency, etc. Bartlett (43) describes a test of business knowledge used in selecting men for non-sales supervisory positions. A somewhat similar test is described by Hepner (179).

Strong (420) uses the Interest Inventory to distinguish between ninety-nine certified public accountants and other occupational groups.

According to Davenport (100) inspectors score higher on introversion, as measured by the Personal Inventory, than do foremen.

Of interest from the viewpoint of predicting success in the professions is the work of Roe and Brown (330) on the analysis of qualifications for dentistry, and the very important contribution on the measurement of scientific aptitude by Zyve (480).

In the field of the professions there are also suggested partially standardized tests for the occupation of junior personnel examiner (401), laboratory assistant (402), medical social worker (403), occupational therapist (404), dietician (405), store-keeper (400). The fact that no material on validation is available makes the scientific value of these tests nil.

E. Miscellaneous Tests

In addition to the experimental studies described above, there are a few investigations on selection tests which do not fall readily into any of the groups listed above. There are also a number of studies not primarily concerned with the selection of workers which should, nevertheless, be brought to the attention of those interested in the application of psychology in industry.

Among the former is a number of articles dealing with the selection of policemen. O'Rourke (300) summarizes standards and procedures employed in the selection of policemen in sixty American cities, and describes a battery of tests developed by the Research Division of the U. S. Civil Service Commission for the selection of policemen in the District of Columbia. Psychological tests employed in the selection of policemen in Europe are reviewed by Viteles (451), who includes examples from the work of Schulte (359) in this field. The author draws attention to the inadequacy of the criteria employed in most of these studies. An article on tests used in the selection of policemen in Bavaria is contributed by Graf (166), who gives much material on qualifications, on administrative procedures, but little experimental data. The intelligence of policemen in Palo Alto and its relation to survival on the police force are discussed by Merrill (272). In the literature of the period are found suggested and partially standardized tests for police sergeants (28), policewomen (29), and a report of selection of policemen in Syracuse (30).

Material on the selection of Army recruits is embodied in a volume on *Psychology and the Soldier*, by Bartlett (45). Awaji (42) reports satisfactory results obtained from the application of group tests (modelled on the pattern of the American Army Tests) to 6,000 recruits of the Japanese army. Positive relations between the O'Rourke classification test scores and fitness for service of 1,000 Navy recruits over a period of one year as measured by promotion and incidence of delinquency; and negative relations between test scores and delinquency are reported in an interesting article by Cummings (98). An article by Klutke (213) embodies a description

of tests used in the German Post Office service for the selection of telephone operators, telegraphists, etc.

A group of "psycho-motor," "sensory," and "mental" tests are used by Drill (114) in the selection of twenty-four firemen. Modified trade tests, involving the ascent of a ladder and the search for objects in a room filled with smoke are reported as showing the most satisfactory correlation with ratings by fire chiefs, after nine months of service. Positive relations between scores on a group test of mental ability and the degree of efficiency of delivery men, as determined by ratings, bonus reductions, and turnover, are noted by Johnson (201). Knoop (222) describes a battery of tests used in selecting 30 workers from among 125 applicants for service with a company engaged in furnishing a service for ordering cabs.

Among articles having a bearing on the selection of workers, although not concerned with selection for specific occupations, is a description by Feist (133) of tests which have been used by Poppelreuter, Giese, and others, in measuring "presence of mind" in fear producing situations. The suitability of Piorkowski's "attention and fatigue" meter as a test of attention is experimentally investigated by Verwoerd (447), whose careful analysis shows no justification for the suppositions underlying the use of the test in the measurement of distribution of attention. A test useful in examining workers for occupations involving the regulation of temperature is described by Liebman (247).

Tests suitable for the measurement of spatial perception and spatial imagery and problems involved in such measurement are discussed by Krüger (225), and by Braunschweig (72). Dietz (105) comments critically on procedures for the administration and scoring of tests of the ability to estimate the size of lines, angles, etc., and describes a test for the estimation of length of lines.

The measurement of technical intelligence is the subject of discussion by Lossagk (255). Schultz (360) describes a mental alertness test held to be suitable for the selection of junior employees. Further data on the reliability and validity of tests of musical aptitude is found in articles by Brown (77), Larson (241), Stanton (406), Gaw (153), and Nielsen (294). Meier (269) contributes a report in an essay on the measurement of art talent.

The existence of individual differences among workers on farms and the use of tests for measuring such differences are discussed by Dunlap (115).

Among other miscellaneous tests are partially standardized tests for housekeeper (396), and for food inspector (395).

F. Trade Tests and Rating Scales

The trade test as a measure of vocational fitness continues to receive scant attention. A few of the tests referred to above, particularly those suggested by the Bureau of Public Personnel Administration, involve trade test situations, but there are no titles dealing specifically with such tests.

There are likewise few titles on rating scales in the period covered by this review. Kornhauser (216) completes his series of excellent articles devoted to a statistical analysis of rating scale techniques. The final article, given over to a comparison of ratings on different traits, includes data on the relative standing of traits with respect to the reliability of the ratings on these traits, findings on the intercorrelation of traits, etc. That ratings are not wholly worthless on purely statistical grounds; that, judged by non-statistical criteria they may be of real value, and that procedures for rating can be improved, are the general conclusions following from Kornhauser's careful study. In contrast to the thoroughness of Kornhauser's evaluation of the contribution of rating scale technique is Bartlett's (44) uncritical eulogy of the rating scale as a selection instrument. Kneeland (214) demonstrates the existence of a lenient tendency in rating by reference to the use of three scales involving close to 2,000 ratings in connection with the study of clerks and section set-up in a department store. The improvement of a scale for rating motormen by the substitution of specific operations for descriptive adjectives is reported by Shellow and McCarter (371).

G. Non-Test Factors in Selection

A summary of earlier work on non-test factors in selection is included in the volume by Hollingworth (189) to which reference has been made. Of interest to industrial psychologists is Kornhauser's (218) determination of the value of opinions given about students entering college by former teachers, employers, and others in a comparison of four reference reports. There is a definite need for the application of similar procedures in evaluating the use of reference report forms in the selection of workers.

A unique and fruitful approach to the investigation of possible prediction of vocations and success from photographs is employed by Landis and Phelps (238) in an investigation of the judgment of forty photographs of successful and unsuccessful men in four vocations. The results, reported in detail, show that a group of untrained judges are unable to determine vocation and relative success

from the examination of photographs. A repetition of this experiment upon trained observers in industry would be desirable. Of general interest from the point of view of judging intellect from photographs is an article by Gaskill, Fenton and Porter (152).

Character analysis is further "debunked" in an article by Laird (236). On the other hand, Engelmann (126) finds that a "first impression" of the ability of printing apprentices, obtained in thirty seconds, agrees with psychological test scores in all but two of twenty cases. However, the twenty cases appear to be a somewhat selected group from 273 apprentices. Meili (270) shows that character judgments made by "chance" coincide with the subject's estimates and satisfy him in as great a number of cases as those made on the basis of an examination of the electrical resistance of cranial areas—in connection with a system of character analysis which has recently obtained great favor in Germany and Switzerland.

The importance of the interview in the selection process is stressed by Anderson (9) in a clear, well organized, and detailed statement on the kinds of observations to be made by the interviewer, on the necessary technical training and the experience of the interviewer, etc. The article embodies an excellent defense of the clinical interview and selection, and an evaluation of the relative contribution of psychological tests and of other techniques in the estimation of total personality to be made in the interview. However, Anderson fails to suggest the importance of applying to interview techniques the same objective standards of evaluation upon which the psychologist insists in the case of other procedures which he employs in the diagnosis of personality. An attempt both to apply interviewing techniques and to evaluate them in connection with measurement of character traits in the selection of prohibition officers is described by O'Rourke (301). That there are elements of error in the procedure is recognized both by the author and in an editorial criticism of this work (31), but it represents, at least, a step in the direction of standardizing and objectifying the interview. An annotated bibliography on the interview is provided by Moore (282).

The possibility of using handwriting as an index of vocational and other aptitudes continues to receive attention, particularly at the hands of European investigators. In German there appears to be a frame of mind receptive to graphology. An indication of this is to be found in a new edition of the classic work by Klages (211). Another volume by the same author (212) includes a description of the evaluation of handwriting of individuals in many occupations by

twelve graphologists in four countries. A volume by Saudek (349, 350) represents another major contribution in this field. Hall (171) concludes that handwriting furnishes a suitable criterion for selection in commercial occupations from a study involving rating by thirty-four judges of the competency of nineteen students in a commercial school, and a correlation of ratings by a graphologist with ratings on accomplishments, etc. Kügelgen (227) finds that ratings on the moral qualities of forty-eight printing apprentices, based on an examination of handwriting, coincides with tests of mental ability and intelligence in 66 per cent of the cases, and nearly coincides in 21 per cent of the cases. Bobertag (64) reports on the comparison of character judgments of five subjects by 18 acquaintances and by six graphologists. The graphological ratings, according to the author, appear to be fairly valid. However, the graphologist will find little consolation in a comparison by Schorn (356) of the judgment of five graphologists on one subject. A keen analysis by the author shows marked disagreement among graphologists, and a ubiquity of "empty phrases" and of statements of very general application. The need for more carefully controlled evaluations of the contribution of graphology in the measurement of aptitude and of character is pointed out by the author.

The effect of social status, age, education and related factors in occupational success is the subject of a number of investigations. An excellent example of this type of investigation, including a study of the relationship between success in college courses, extra-curricular activities, organizations in college, to success as an employe of the Bell Telephone Co. is reported by Bridgman (375). Ching (88) shows the influence of age, training, academic and other experiences on progress in a group of scientific occupations. The significance of age, education, intelligence, etc., in relation to success as a sections manager (186) in a department store, as a sales clerk (187), and as a messenger (188), is described by Ho. That social status of parents does not influence the length of service in clerical occupations is the conclusion of a study by Bergen (55). The effect of residence in city and country upon success as an apprentice machinist is discussed by Krüger (224).

H. Analysis of Occupational Qualifications

The study of occupation qualifications continues to receive little attention in the literature as a distinct item. Both the techniques of job analysis and findings from the application of its technique are discussed in many of the articles on tests described above.

Geissler (155) discusses the need for job analysis and describes the form used for this purpose in the textile industry (154). The technique used in analyzing jobs to determine their suitability for handicapped girls is described by Dye and Unger (118). Feick (132) analyzes the activities characteristic of workers in various bank jobs and presents a highly subjective analysis of the necessary mental qualities associated with these activities. Ruffer (338) classifies 100 specialized office jobs into 19 groups and assigns a rating on the degree of competency for each group on such qualities as logical memory, persistence, etc. Breithaupt (74) points to the possibility of using the records of penalties imposed in the industrial plant in analyzing desirable qualifications. Tests of finding rhymes, completion of poetic fragments, association of verbs with nouns, etc., are employed by Stumberg (422) in an analysis of poetic talent.

Of general interest, from the viewpoint of job analysis, are the sample job specifications published by the American Council on Education (5) and statements on qualifications and psychological and sociological factors affecting success in occupations for women by Hatcher (175).

III. APPLICATION OF PSYCHOLOGY IN MERCHANTISING

In an earlier review (454) it has been pointed out that the application of psychology in merchandising has taken two directions, (1) an attempt to rationalize principles of human behavior, as revealed by laboratory investigations, in terms of the specialized performances described as buying, selling, advertising, etc., and (2) an attempt to set up experimental conditions, that is, to apply scientific techniques in investigating the factors influencing these forms of human response.

Among major works appearing in recent years illustrating the first tendency is a volume by Eichler (124) embodying a series of generalizations, not experimentally verified, on the psychology of selling. This represents an example of the tendency referred to in earlier reviews toward a "practical common sense" but not always valid application of psychology to selling.

In somewhat the same category is the discussion of argument and suggestion (patterned somewhat after Scott (366)) in outdoor advertising (303), and a book on practical salesmanship by Pelz (309). Swift (423) includes didactic generalizations on selling in chapters of a volume devoted to methods for influencing human conduct.

A characteristic example of the second tendency is a monograph by Roloff (332, 333) given over to a description of an experimental study of the effectiveness of posters. Following the failure of a jury of specialists to agree in the selection of eight posters from among 77 submitted in a contest the synthetic and aesthetic value of the posters and their forcefulness were studied by obtaining ratings from about 100 subjects, each of whom observed the posters for a period of 15 minutes. Ratings by these observers, as well as by 300 readers of an advertising periodical, confirm the judgment of the members of the Committee who were engaged professionally in the practice of advertising. The purpose of this study, the methods employed, in spite of possible weakness in detail, make it a significant experimental contribution in the field of merchandising. It is interesting, in passing, to note in an article by Karsten (204) another example of an experimental evaluation of designs submitted in a prize contest.

A volume by Franken and Larrabee (138) also furnishes an example of the application of experimental methods to problems of advertising. The authors find, in the course of a series of experiments conducted on students of New York University, that packages colored orange and yellow give the impression of greatest size. Preference on the part of this highly selected group for other factors in connection with packages is also tested. In the same group is an earlier publication by Hotchkiss and Franken (193), reporting the use of the controlled association method in investigating the recall of commodity names and of manufacturers' names and brands. Variations in familiarity over a period of years, the effect of advertising upon recall, sex differences, advertising policies, etc., are analyzed in this detailed experimental study.

In the case of most of the larger contributions on the psychology of merchandising, the two tendencies referred to above are combined in varying degrees. So, for example, Greenly (169) combines a reference to experimental work with a general discussion of psychology as a sales factor. In an interesting, well written book by Marbe (264) stress is laid upon the dependence of practical advertising upon psychological theories and principles. Brief descriptions of investigations in this field are included, although the emphasis is on the bearing of principles developed by the experimentalist in the psychological laboratory. Hahn (431) contributes a translation of a volume on the principles of advertising by Tipper, Hollingsworth, Hotchkiss, and Parsons.

The journals furnish a number of shorter general and experimental articles on the application of psychology in merchandising. Experimental studies on selling are fewer than those on advertising. Among the few experimental studies in the former field is an essay in the investigation of personality as a factor in sales success. The author (146) uses a test of introversion and extroversion involving an observation of differences in the intensity of tones heard during reverie and while the subject is attending directly to the stimulus. Results of 30 subjects, compared with ratings, lead the investigator to the optimistic conclusion that in extraversion of personality, as measured by these tests, is to be found the secret of sales success. Bergen (56), on the other hand, finds that the real secret of success in selling is in the use of suggestion. Donaldson (112) outlines 5 criteria of personality expression in business. A shopping tour by 120 students is used by Phillipps (312) in a study of glaring defects in retail selling.

In the case of advertising, the experimental approach is embodied in a number of studies characterized by a careful control of the variables under observation. In some instances, the studies represent the further investigation of problems upon which the authors have been working for some years.

An example of the application of laboratory techniques and standards in the examination of advertising problems is to be found in an investigation by Nixon (295) of differences in the time taken to differentiate advertising from nonadvertising matter in newspaper and periodical publicity. The results obtained by the use of a special tachistoscope and 49 subjects, constituting a fairly representative sample of the population (a condition overlooked in many experiments in this field), and colored and noncolored editorial and advertising matter indicate that color makes little difference in the speed of perception of advertisements, and suggest the desirability of the use of "hard to perceive" styles of layout by continuous advertisers.

Burt and Crockett (82) apply to advertising posters the laboratory techniques employed in studying recall and recognition of publication advertising in driving 19 observers by two series of 40 posters at the rate of 20 miles an hour. The authors cite results on the influence of primacy and recall, the relative recall of picture ads, commodities, trade-marks, etc., but point to the many uncontrolled variables affecting the results in this experimental situation.

The relative significance of intensity, repetition, and allied factors

influencing recall of advertisements continues to receive the attention of investigators. In one experiment by Adams (3) 100 students, familiar "dummies" and techniques are employed with changed material—single words on quarter, half and full pages—to show that the isolation of a single word on a full page has no effect on its recognition value, but that repetition is effective. That there are applications of findings in this artificial situation of significance for advertising is, of course, questionable. In a later experiment by Adams and Dandison (4), who employ colored squares of various sizes, the relative recall value of one unit of area is shown to be 1.00, of two units of area 1.6, and of four units of area 1.68. Another experiment, involving the use of four-letter words in various arrangements, reveals a distinct rise in curve of recall after five repetitions of the word. With a variation of procedure significant differences are revealed, indicating increases in attention value of size and in memory value of repetition.

The value of absolute size is examined by Newhall and Heim (293), who show one of three sets of ads of various sizes to one of three groups of college students. Results obtained through recall by the method of paired associates lead to the conclusion that the value of commercial advertising is apparently independent of absolute magnitude.

The belief in the superior "drawing power" of the positive advertisement is well entrenched among other traditional beliefs. The validity of this belief is investigated by Lucas and Benson (256) in a comparison of returned coupons for ads matched for time of appearance, periodical, size, etc., but differing in direction of appeal (*positive* versus *negative*). The percentage of coupons returned and cost per returned coupon are studied. The findings show no difference in appeal between positive and negative ads, no sex differences, and that variations within each of the two types are greater than the differences between the two. The findings are highly suggestive, although they give no clue as to whether the doctrine that unpleasant experiences are suppressed in memory applies to advertising. The historical method favored by Kitson is applied by the same authors (258) in studying the trend of advertising since 1912, which shows an increase in advertisements with negative appeal since 1922—an increase of 12.3 per cent in 1922 to 35.2 per cent in 1927. Disagreement with Kitson's earlier findings are discussed and explained by the author.

Strong and Laslett (421) offer further evidence in support of

the superiority of the "want" as compared with the "commodity" advertisement obtained in an experiment involving 108 men and 18 women in a general psychology course.

Asher (39) uses results from a comparison of a paired associates test with expenditures in newspaper advertising to study the influence of such advertising upon familiarity with retail stores. Although recognizing the complexity of the variables involved, the author interprets his data as indicating that advertising is the most important single factor in determining familiarity with retail stores.

In a study by Schmidt (353) is carried further the analysis of confusion of designs (trade-marks) undertaken earlier by Marbe. The experiment, characterized by a careful control of such factors as intervals between presentation of designs, degree of resemblance, etc., lead to conclusions such as (1) frequency of confusion varies directly with interval between the presentation of two series, (2) accuracy of recall varies directly with length of series, etc.

Bartlett (46) indulges in highly metaphysical speculations on mental factors underlying the control of the "will to buy" through advertising.

During the period covered by this review additional evidence on the legibility of various type bases has been obtained. Tinker and Patterson (428) find that 640 subjects read material in lower case types 13.4 per cent faster than that in all capitals (as against 10 per cent in Starch's experiment). The rate of reading material in capitals is 2.8 per cent faster than that of reading italics. Different forms of the Chapman-Cooke Speed of Reading test are used for reading material. In a later article by the same authors (429) on the legibility of the size of type are outlined the requirements for an experiment in this field. Results are reported showing that 10 point type yields the fastest reading of the five types used under the conditions set up in this experiment. In a still later article on the length of line (430) the recommendations of other investigators are reviewed. An experiment, involving the use of 10 point type, shows the superiority, from the viewpoint of rate of reading, of the 80 mm. line. The optimum length of the size of line is said to be between 59 and 97 mm., but closer to 97 mm. The relative effects of line changes on slow, fast, and medium readings, are discussed in the final article of this model series in this field of investigation.

From the results of a somewhat more involved experiment designed to determine the relative legibility of Intertype Ideal New

Face Type, set up in standard newspaper form, as compared with other types, Hovde (191) concludes that context is more important than form of type in determining legibility when reading rate is used as a criterion. Preference of type appears to give no clue to legibility.

Burtt and Beck (83) report a well arranged experiment to determine the legibility of three types of "backbone titles". The results show the consistent inferiority of one type and the desirability of considering for use another seldom employed.

Advertising as used by the German railways is discussed by Sarter (348), in the electric lamp industry by Prox (323); Kurtzig (229) expresses the need for exact data on the value of film publicity.

IV. OTHER INDUSTRIAL APPLICATIONS

The writer has discussed in an earlier review the interest of the industrial psychologist of Europe in problems investigated in this country by industrial engineers. This difference in attitude between European and American psychologists is also referred to by Kornhauser (217) and is further reflected in the contents of many of the foreign books and articles reviewed above under "*Scope of Industrial Psychology*". The inclusion of chapters on methods of work and the effects of environment in Burtt's (84) recent book may suggest a growth of interest on the part of American investigators in what Giese has termed the "object psychology" of work, but, actually, American technical journals remain about 99.44 per cent pure in so far as interest in the materialistic aspects of industrial surroundings are concerned. On the other hand, in European journals numerous articles appear on the effect of ventilation, of illumination, and of other conditions of work, as well as articles on time and motion study, machine construction, etc.

As in the earlier reviews (454, 455) and for reasons stated there, no attempt will be made to cover in the present summary studies of the types mentioned above. The reader interested in such studies is referred to the *Journal of the National Institute of Industrial Psychology*, *Industrial Psychotechnik*; *Psychotechnische Zeitschrift*; *Revue de la science du Travail*, the reports of investigations by the *Industrial Health Research Board of Great Britain* (formerly Industrial Fatigue Research Board); and to excellent summaries of these investigations appearing from time to time in the *Journal of Personnel Research* and in *Psychological Abstracts*. There are,

however, a number of contributions on the application of psychological principles and techniques in analyzing the causes of accidents, in the analysis of motives, in studying the attitudes of workers, and on similar problems of general interest from the viewpoint of "subject psychology" of work (to adopt Giese's terminology), which have been selected for review.

Among major publications on the applications of psychology in industry, exclusive of vocational selection and merchandising, is a book by Burt (84) with chapters on training, fatigue, methods of work, satisfaction and morale, etc. This well organized and well written volume, embodying a wealth of data from experimental studies and an appreciation of the contribution of laboratory psychology, represents a valuable addition to the literature of industrial psychology.

(a) *Accidents*

The industrial *accident* as a specific problem is considered in a number of recent American and foreign publications. Farmer (131) summarizes findings reported in earlier studies on the influence of individual differences and of other factors in accidents. In a series of articles by Bingham (63) and by Slocumbe (373, 374, 375) are reported the findings of an investigation on the causes of accidents on the part of transportation workers and reduction of accidents through individualized study and treatment of accident-prone employes. Of particular interest, in addition to the confirmation of the existence of individual proneness to accidents and the analysis of factors underlying proneness, is the application of the clinical method to counterbalance the factors creating susceptibility towards accidents on the part of the individual.

Accidents involving motor vehicles is also the subject of an article by Ach (1), who insists upon an inherent conflict between speed of operation of motor vehicles and the psychophysical capacity of the individual to react quickly and accurately enough at these high rates of speed. The control and registration of speed, education of pedestrians, etc., are recommended as ways of avoiding transportation accidents. The significance of reaction time in the application of the brake, as a factor in vehicular accidents, is also stressed by Tramm (435). Psychological problems in railway accidents are discussed at length by Grüb (170).

The influence of individual differences in accident causation is pointed out by Viteles (453). A study by Stevens (412) of 5,000

cases receiving compensation for injuries at work shows a high positive correlation between duration of disability and age in the case of nearly all injuries.

Significant sex differences in susceptibility to automobile accidents are reported by Viteles and Gardiner (452), who find that women cab drivers have three times as many accidents per thousand miles of operation as men driving similar equipment under similar conditions.

Susceptibility to accident is also studied by Hildebrandt (182) in a comparison of three apprentices with accident records and three apprentices with records of no accidents. An analysis of findings on psychological tests and ergograph curves lead the author to conclude that the first three apprentices experience accidents because of instability and by reason of incapacity to concentrate attention unless interest is strongly challenged in the work. A critical discussion of the significance of differences in reaction time is included in this article.

Illustrative of investigations on the influence of conditions of work upon accident rate are to be found in recent publications of the Industrial Health Research Board of Great Britain. So, for example, significant differences in accident traits between poorly and well ventilated mines is reported in a number of studies (440, 442). Variation in incidence of accidents with output and with turnover, with distance of seam from mouth of mine, its age, are also reported in the case of miners in these studies (440, 442). Conclusions concerning the influence of illumination on accident rate are cited by Polakov (315). The contributions of scientific management to accident reduction are discussed by Martens (265).

Figures on frequency of accidents under day and piece work systems of payment, in which the latter is associated with a lower accident rate, are published by Lippman (253). However, the author cautions against drawing final conclusions from these figures because of the presence of variables other than systems of wage payment.

Brakeman and Slocum (69) contribute a painstaking review of experimental results relative to the study of individual accidents and susceptibility under the headings of vision, reaction time, fatigue, attention, kinesthesia. The review is limited to laboratory investigations which have a bearing on the practical industrial situation. As a result of this restriction and of the absence of German titles many findings and conclusions of utmost importance from the view-

point of accident susceptibility are missing from this otherwise excellent summary.

B. *Training*

In addition to chapters on *training* in a number of the texts mentioned elsewhere in this review there have appeared a few books and a number of articles specifically devoted to training and involving an application, to a greater or less degree, of psychological principles in training workers. The systematic instruction of motormen, of workers in shoe factories and in the metal trades is used by Carrad (364) in illustration of the theory and practice of training on psychological grounds. The factors to be considered in the organization of an industrial training program are discussed by Moede (281). Rupp (343, 344) discusses the foundations of a "vocational pedagogy". He weighs the relative advantages of direct training in the factory and in trade schools, and the significance of such factors as interest, incentive, etc. Of particular interest to the industrial psychologist is his criticism of the practice of isolated units of a trade activity such as holding the hammer, grading the force of the blow, etc., as recommended by Berling (57). The latter employs training in the use of the file divided for practice into such elements as rhythmic movement, maintenance of constant pressure, etc., in illustration of the "part" method of training, recommended by him. A contribution to this problem of training is made by Dilger (106), who compares the progress of two groups of workers, as trained in the use of the file, (1) through practice on the whole activity on production work, and (2) by means of special tools and special procedures. His results point to the superiority of the former method.

Nebel (290) illustrates the use of careful time study, of moving pictures, etc., in formulating the best methods of filing for purposes of training. The author refers to reductions in training time following the introduction of such training methods. He also briefly reviews the earlier literature on training.

Findings and conclusions of significance from the viewpoint of training manual workers are, of course, to be found in a number of the articles discussed above, under the caption of "The Measurement of Motor Capacity".

In view of the few objective studies on the value of organized training, there is unusual interest in a comparison by Krüger (226) of systematically trained machinist apprentices with apprentices not

profiting from systematic training. The benefits of organized training are demonstrated in this study, involving the preparation of stock articles by apprentices. The author describes the methods employed in training, which include regular practice on isolated operations.

The intimate relation between scientific selection and training is referred to by Koblanc (221) and by Bolt (67), who use in training exercises similar to those employed in selection.

Developments in training for specialized occupations, in part through the application of psychological techniques, are described in a number of publications. Outstanding among these is a detailed description, by Schwarze (363), of methods and materials employed in training workers on the German railways. Couvé (94) also writes on this subject. Among other contributions of this sort is material on training transportation workers by Herwig (181); on locomotive engineers, by Schuschakow (367); on sales people, by Tumena (438); on glass blowers, by Bolt (67); on clear enunciation for long distance telephone operators, by Schuck (357).

The significance of habit interference and related forms of behavior in training transportation workers is discussed by Viteles (453). Kneeland (215) outlines a set of arbitrary rules for the use of the interview in training sales people. Dixon (109) refers to the development of a training class for increasing the "personal efficiency" of supervisors.

Of general interest, although not primarily oriented from the viewpoint of the psychologist, is a verbose but detailed description of procedure for organizing training by Greene (167) and a shorter article (168) by the same author; a volume on training sales employees by Burlton (80) and articles on apprentice training by Woodruff (470), on training in a chocolate factory by Payne (305), and on training foremen.

C. *Monotony*

The influence of *monotony* upon the efficiency and well being of workers in industry is treated in a number of the articles which have appeared in recent years. The factors conducive to boredom in industry (including specialization, methods of bringing material to workers, individual differences in intelligence, variations in the estimate of time) and methods for reducing boredom in industry are discussed in a series of broad generalizations by Wyatt (471, 472).

The "total situation" is again stressed in a brief discussion of monotony by Mayo (266).

An experimental study of a repetitive process is reported by Wyatt (473), who gives a general intelligence test, a series of manual tests of the analytic type, and a miniature test to 30 female wrappers in a soap factory. No significant relationships appear between any of these and an output criterion. Questioning of the girls and casual observations lead Wyatt to conclude that the dislike for the work is the feature of boredom and that it may be caused by lifting of weights required on the job, by an unequal distribution of supplies, by posture, and by the nature of the machine.

In a still later investigation by Wyatt, Fraser and Stock (475), we find a feeling of boredom fairly prevailing in 49 factory workers, (including filament winding, soap wrapping, etc.) only 13 of whom seldom feel bored. An association is noted by the authors between boredom and reduced work, fluctuation of production as reflected in changes in the shape of the work curve, overestimation of time intervals, intelligence, system of wage payment, etc. They also discuss changes in methods of work which may result in a decrease of the feeling of boredom. The subjectivity of the "monotony" criterion must be carefully weighed in evaluating the findings of this study.

The work of other investigators in the field of monotony is reviewed by Thompson (432), who criticizes the failure of Wyatt and of Burnett to differentiate clearly between "efficiency" and "freedom from susceptibility to monotony". The author uses as a criterion of susceptibility to monotony a questionnaire on daily habits, in the form of a graphic rating scale, filled in both by the subject and by others acquainted with him for from 1 to 3 years. He finds a correlation of +0.71 between the criterion and a battery of four measures, including an emotional history record, "production decrement" on two performance tests and the score on an intelligence test. The outstanding weakness of this study is likewise in the subjective character of the criterion of monotony.

A laboratory study of one subject by Pollock (316), involving a long and short spell of work in pushing a small ball by means of a knitting needle, past obstacles, up an incline, leads to findings and conclusions of significance from the viewpoint of the problem of monotony in industry.

An interesting approach to the examination of susceptibility to monotony is embodied in an investigation by Lossagk (254), who

examines differences in time estimation, by subjects (a) while looking at a blank wall, (b) while engaged in performing a simple automatic operation, and (c) while engaged upon a complex operation. The results lead to tentative conclusions on the applicability of this method in selecting for repetitive work those who are least susceptible to monotony.

Music is suggested as a counter irritant to the feeling of monotony by Younger (479).

D. *Motivation*

An increasing interest in the motivation of the worker—his attitude, feeling tones, and in the development of experimental techniques for their studies is reflected in the literature of the last few years. The influence of aptitude for work, training, conditions of work, rest pauses, regularity of employment, etc., upon the "will to work" is discussed in a common sense application, by Miles (276), of psychological findings to the problem of industrial motivation. The importance of evaluating scientific personnel procedures in terms of workers' satisfaction, as well as in terms of efficiency, is stressed by Kornhauser (219) in recommendations for the study of worker's feelings.

Significant findings on workers' attitudes grow out of an extensive and unusually well controlled investigation reported in a series of articles by Pennock (310, 311), and by Putnam (311, 325). The effect of the introduction of changes in wage payment, rest pauses, illumination—varied one at a time, is studied. An increase of production resulting regardless of the character of the change is explained by the author in terms of changes in mental attitude paralleling the variation in conditions of worker. This finding on the significance of mental attitudes in production leads to a direct study of workers' attitudes by means of confidential interviews, in which the worker is allowed an opportunity to give free expression to his opinions on every phase of plant operation. The importance of the information so obtained in developing a sound employes' relation policy, and in the adjustment of individual workers, is stressed. A by-product of this study is a supervisory training program in which information on employes' attitudes is employed.

Similarly important from the viewpoint of objective methodology in the study of employes' attitudes are the procedures adopted by Houser (194) in an investigation of what the employe thinks. The

analysis of trends of thought follows directly from answers to specific questionnaires.

In contrast to this direct approach of employe attitudes is the method employed by Lossagk (256), who studies the attitudes of employes toward their work by sending questionnaires to foremen. The investigation is worthy of note by reason of the naiveté of its procedure.

A study of emotional tones and attitudes of 12 male workers by Hersey (180) reveals a cyclical change from "happy" to "worried" apparently associated with such factors as changes in the blood pressure, feelings of fatigue, etc. The approach is interesting, but only the most tentative conclusions can be drawn because of the number of cases, the subjective character of ratings on emotional tone, and by reason of liberties taken by the author in completing curves.

An attempt to analyze workers' attitudes, with particular reference to the introduction of machinery, is included in an investigation by a sub-committee of the German Industrial Inquiry, described by Lippman (252, 32). Generalizations on the attitude of workers toward the introduction of machinery are included in an article by Davies (101). Fox (137) becomes emotionally upset at the machine's domination of man, in a criticism of industrial engineering. DeMan (102) investigates the attitude of workers to machines, by means of a questionnaire to 78 members of the Akademie der Arbeit of Frankfort. The limitations of this method are recognized by the author.

Jones (202) refers to the operation of "mental inertia" or perseveration in the genesis of attitudes of workers.

A consideration of workers' attitudes toward research procedures is urged by Poppelreuter (319), who describes an instance of objection on the part of workers to submit themselves to psychological examinations. The author concludes that the psychologist should, in so far as possible, avoid imposing tests against workers' wills, although, as he points out, this has been rarely necessary.

The effect of *financial incentives* is studied in other investigations. Ketzer (208) compares day and piece systems of payment in the case of a "good", a "fair", and a "poor" packer and finds that with a piece wage there is an increase in average daily production and a disappearance of the individual form of the work curve. Vernon (443) finds that a bonus tends to increase speed in work and to over-fatigue unless an adjustment is made in working. The beneficial effects of financial incentives on the attitudes of workers

is discussed by Schomerus (355). In the consideration of financial incentives the industrial psychologist will be interested in a description of wage incentives and their administration by Lytle (260).

E. Maladjustment

Closely related to the study of workers' attitudes and motives is an analysis of factors determining the *maladjustment* of individual workers in industry. The literature of the last few years includes a number of papers reflecting the point of view that vocational adjustment is a dynamic problem, involving a careful analysis of employes at work, and the readjustment of the employed worker, as a supplement to the scientific selection of competent personnel. This outlook finds expression in an article by Anderson (10) proposing a staff consisting of a psychiatrist, a psychologist, and a psychiatric social worker to handle problems of worker maladjustment. The actual operation of such a plan is described in his volume on psychology in industry and in articles by Dixon (111), Ray (336), Laughead (240).

Toulouse (434) uses results obtained from the examination of patients in a mental hygiene clinic to estimate the loss in earnings to workers suffering from mild psychopathic disturbances, and expresses the opinion that the total loss amounts to hundreds of millions of francs. He points out the usefulness of the psychiatric examination, supplementing the psychometric examination of aptitudes, as a means of decreasing the incidence of such psychopathic disturbances in industry. The significance of mild psychopathic disorder finds striking confirmation in the findings of Smith and Culpin (379) on the heightened degree of susceptibility to telegraphist's cramp of "neurotics" in this occupation. The elimination of psychoneurotics from this occupation by the use of validated selection techniques is recommended by the authors.

Culpin (99) discusses the incidence of "nervousness" in industry. Mayo (267) stresses the consideration of the whole individual and his adjustment as the proper subject of investigation in the promotion of human efficiency in industry. Programs for promoting the adjustment of the feeble-minded in industry are described by Burr (81), Raymond (327), and Bernstein (58).

F. Fatigue

Although appearing incidentally in a great many studies on conditions of work, *fatigue* as a specific psychological problem appears in but few publications. In general, the approach is physiological

rather than psychological. A few titles representative of the latter approach in the study of industrial fatigue are briefly summarized below.

The emphasis on underlying physiological factors is well illustrated in a volume edited by Atzler (40), embodying contributions from leading German investigators in the fields of anatomy, physiology, the measurement of fatigue, etc. Of particular interest to the psychologist are the chapters on the theory of fatigue and the discussion of its measurement, and chapters on fatigue in industry. An excellent bibliography accompanies each chapter. In the same category is another much shorter collection of papers on fatigue (54). The problem of objective measurement of industrial fatigue occupies primary position in this survey of work in fatigue, although little attention is given to psychological methods for its measurement.

The influence of conditions of work is reported in many studies. Of historical interest is a description of an early investigation by Imbert (198) of changes in respiration, circulation, and other indices of fatigue in the transportation of bread on a pushcart, undertaken to settle a disagreement between bakers and porters concerning the weight of a reasonable load. Paralleling this a more recent investigation of the physiological cost of muscular movement in transporting bricks on a barrow, by Crowden (97).

The effect on oxygen consumption, pulse rate, blood pressure, etc., of different methods of carrying load is studied in another investigation (86). Laboratory and plant investigations on the effect on fatigue of length and shift (445), of rest pauses (476, 445, 446, 262), of high temperature (441), of speed of work (274), of variety and uniformity of work (474) are discussed in a number of publications.

The harmful effect of noise, from the viewpoint of fatigue, as measured by changes in production in typing and by a greater expenditure of energy, is discussed by Laird (237). Results somewhat contradictory to these findings on the effect of noise are reported by Kornhauser (220). However, differences in the conditions of the two experiments must be noted.

The significance of physical factors in work and fatigue is investigated in a comprehensive study of physical characteristics of women in industry as compared with those of control groups (87). The effect of eye strain is considered in other studies (467, 468). Hill (185) contributes a treatise on recent additions to the knowledge of physical and chemical factors in recovery from fatigue in muscular movements of men.

Of more direct psychological interest is the explanation by Lewin (246) of fatigue and of monotony in terms of psychic satiety.

Among laboratory investigations of significance from the viewpoint of fatigue is Neifeld and Poffenberger's (291) treatment of Joteyko's expression of the curve of work, Weinland's (464) study of variability of performance in the curve of work, and Flügel's (135) results in a study on practice, fatigue, and oscillation.

Goldstern (164) contributes a conscientious study of the influence of fatigue as determined by errors in exact measurements by use of the polarimeter by 20 subjects. The article includes a lengthy bibliography. Verwoerd (448) questions the suitability of the "attention and fatigue meter" of Piorkowski as a measure of fatigue in tasks involving distribution of attention on the basis of the findings in an experiment with this instrument.

The effect of rhythm on fatigue is discussed by Sachsenberg (346) on the grounds of an investigation in a cigarette factory in which the introduction of a suitable rhythm of work was followed by an increase in the number of boxes packed and by decreased fatigue.

Rupp (345) contributes an analysis, in subjective terms, of psychological factors affecting production where the moving belt is employed, and of the effect upon the fatigue and attitudes of workers of this innovation. Experimental results are cited by Dukin (116) to demonstrate the lowered fatigue of an imposed rhythm of work. The author draws conclusions therefrom upon the desirability of the use of the moving belt in industry. Lehmann (244), by the use of the ergograph and of sustained weights, measures the cost of dynamic versus static work and finds the former to be more costly. He also contends that simultaneous work with both hands results in less production than the successive manipulation of two hands.

A review of laboratory investigations bearing upon the measurement of fatigue by the respiratory method is contributed by Neoussiki (292). Dean (101a) publishes a comprehensive bibliography on fatigue and allied subjectives.

G. Management

A number of books and articles are devoted to the psychology of management. In a volume by Metcalf (273) are included a series of excellent papers by psychologists on the application of psychology to various aspects of management in industry. A very general and nontechnical treatment of such factors as habit, the forces of per-

sonality, problems of self-control, etc., as applied to the problems of supervising workers is contributed by Smith (377) in a treatise on psychology for executives. A final chapter is devoted to the concept of integration in management as modeled after Follett. A somewhat similar approach is embodied in a volume by Tread (427), likewise given over to a general, nontechnical treatment of psychology as related to management. Although, as is true of other books in this field, tending toward wide generalizations, both volumes embody a good deal of material of value to the executive.

Chapters on the psychology of leadership and management are included in a dissertation by Swift (423) on how to influence men. There is a tone of finality in the recommendations and conclusions which hardly seems in place in a field in which there are practically no experimental findings upon the basis of which to formulate conclusive generalizations. The same subject is treated in a reprinting of a volume of Gowin (165).

The relative merits of argument and suggestion, emphasizing the greater suitability of the former in promoting management and sales activities, is discussed by Scott (366) in a new edition of an early work. The general psychological problems of leadership are discussed by Carrard (365). Achilles (2), and Tramm (436) contribute shorter articles on this topic.

H. Miscellaneous

A few additional contributions, *miscellaneous* in so far as character is concerned, remain to be mentioned. Giese (168) makes an unusual contribution to the study of physiological and psychological factors in work in a volume describing investigations on the hand as an instrument of work. A wealth of material on racial and sex differences in hands, on the hand as an agency for expressing subjective states, the pathology of the working hand, as well as upon the hand movements and forms in relation to occupational activity is assembled in this book. Numerous pictures, diagrams and bibliographical references add to the completeness of this volume.

The catholicity of interest on the part of European industrial psychologists is shown in an experimental study of success and failure in games of chance of the slot machine variety by Roloff (334) in order to determine the part played by skill. Results are related to legal definition of games of chance. Poppelreuter (321) contributes a splendid introduction to psychological factors in time study in the form of forty-six principles, illustrated with findings from laboratory

and factory investigations. Gardiner (147-151) publishes a series of articles of little merit on the influence of home conditions upon industrial efficiency.

The effects of ultra violet rays on industrial output involving eleven girls, three of whom constitute a control group, is investigated in an experiment by Punch, Wilkinson, Brooke and Myers (324). A careful control of conditions is supplemented by judicious interpretation of differences in effect produced in the case of the eleven subjects. An experiment by Sowton, Myers, and Bedale (386) is designed to examine the influence of menstrual cycle on bodily and mental efficiency. A series of tests given for a period of from four to six months to thirteen university women and to sixteen factory women ignorant of the object of the tests gave no evidence that the menstrual period in normal women is associated with serious incapacity for mental or muscular work. Observations on one subject on ninety-two consecutive days under controlled conditions of exercise, diet and sleep gave the same results.

Wiechman (462) suggests the desirability for unification of terminology in industrial psychology. He includes with his plea a short German vocabulary of many words used in the same sense in the literature.

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NOTES AND NEWS

Dr. John A. McGeoch, formerly professor of psychology in the University of Arkansas, has been appointed professor of psychology and chairman of the department of psychology in the University of Missouri.

Dr. Addison W. Moore, emeritus professor of philosophy at the University of Chicago, died in London on August 25th. Early in his career Dr. Moore contributed to experimental psychology.

In honor of Dr. George F. Arps, professor of psychology and dean of the College of Education of the Ohio State University, a dinner was given on the tenth anniversary of his deanship. Dr. W. O. Thompson, president emeritus; Julius F. Stone, chairman of the board of trustees; Dr. Boyd H. Bode, and Professor Wilbur H. Siebert, paid tribute to him.

Professor Sigmund Freud, psychiatrist, of Vienna, has been awarded the Goethe prize for scientific and literary distinction.

